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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER	
FISCHER, JUSTIN R	
ART UNIT	PAPER NUMBER
1733	17

DATE MAILED: 08/04/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 07-01)

A8-17

Office Action Summary	Application No.	Applicant(s)	
	09/888,972	NORLEY ET AL.	
	Examiner	Art Unit	
	Justin R Fischer	1733	

-- Th MAILING DATE of this communication appears on th cover sh t with th correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *17 July 2003* .

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6 and 18-31* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 18-31* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11)☐ The proposed drawing correction filed on _____ is: a)☐ approved b)☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12)☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____ .

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

14)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).

a) ☐ The translation of the foreign language provisional application has been received.

15)☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____ .
4) ☐ Interview Summary (PTO-413) Paper No(s). _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: .

DETAILED ACTION

Claim Rejections - 35 USC § 102 / 103

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-6, 18-22, 25-27, and 29-31 are rejected under 35 U.S.C. 102(e) as anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Tzeng (US 6,482,520, of record). The applied reference has a common assignee with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 102(e) might be overcome either by a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not the invention "by another," or by an appropriate showing under 37 CFR 1.131.

Tzeng discloses a process of forming a thermal interface or a heat sink for an electronic component comprising laminating a plurality of flexible graphite sheets, wherein said graphite sheets have a high degree of orientation (directionally aligned) based on the applied compression (e.g. roll pressing) [Column 3, Lines 1-15 and Column 4, Lines 1-9]. Regarding the thermal anisotropic ratio, Tzeng describes a ratio that can approach 20 to 1 or higher (Column 4, Lines 39-44), which includes the claimed ratio of at least 70. While Tzeng fails to expressly describe a ratio of at least 70, a fair reading of Tzeng suggests that high thermal anisotropic ratios can be obtained by densifying the graphite sheet and in view of the range of 20 or higher suggested by Tzeng, one of ordinary skill in the art at the time of the invention would have found it obvious to form a ratio of at least 70 depending on the intended use of the product (what degree of anisotropy desired and/or needed). It is emphasized that Tzeng specifically suggests the densifying of graphite sheet materials to obtain higher degrees of anisotropy and thus higher thermal anisotropic ratios.

Regarding claims 3, 4, 21, 22, and 27, the individual graphite sheets are formed by compressing or compacting expanded/exfoliated graphite particles prior to the formation of a laminated article. The thus formed graphite sheets are then superposed upon one another to form a unitary article and subsequently laminated (i.e. heat and pressure) [Column 10, Lines 7-10]

With respect to claims 5, 6, 19-22, Tzeng discloses that the degree of anisotropy increases upon roll pressing (calendaring) of the sheet material to increased density (Column 4, Lines 28-30).

Regarding claims 18-22, 25-27, and 29, Tzeng discloses a common method of forming the flexible, graphite sheets comprising intercalating natural, graphite flakes (Column 6, Lines 3-51).

With respect to claims 30 and 31, Tzeng suggests that the lateral thermal conductivity is a function of density, wherein increased density results in increased lateral thermal conductivity (Figure 3). It is clearly evident that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet material with a lateral thermal conductivity of at least 350 depending on the desired anisotropic characteristics (by densifying graphite sheet material).

Claim Rejections - 35 USC § 103

4. Claims 23 and 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Tzeng as applied to claim 21 above. As previously set forth, Tzeng is directed to a process of forming a heat sink composed of a plurality of flexible, graphite sheets, wherein the planes of each graphite sheet (graphene layers) are highly oriented as a result of the applied pressure. In describing the applied pressure, Tzeng suggests that the expanded/exfoliated graphite particles are compressed or compacted, for example by roll pressing (Column 4, Lines 1-9 and Lines 45-47). While the reference fails to expressly describe the use of a die press or movable platen, these techniques represent well known and conventional "compacting" means and one of ordinary skill in the art at the invention would have readily appreciated the use of either technique in the process of Tzeng, especially in view of the general description by Tzeng noted above. In addition, the roll pressing or calendaring of Tzeng is only exemplary and suitable

compression or compacting would equally be obtained by a conventional die press or movable platen, there being no evidence of unexpected results to establish a criticality for either of these techniques.

5. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Tzeng as applied to claim 18 above and further in view of Mercuri (US 5,902,762, of record). In describing the laminating of the individual graphite sheets, Tzeng suggests that a pressure sensitive adhesive can be used (Column 7, Lines 1-14). The reference, however, fails to suggest that the individual graphite sheets can be resin impregnated. Mercuri, though, is similarly directed to the use of flexible graphite sheets due to their desirable heat transfer properties, wherein the sealability of said graphite sheets is improved by resin-impregnating said sheets (Column 2, Lines 1-16). In particular, Mercuri recognizes that the anisotropy of said flexible, graphite sheets allows the resin to flow readily within the sheet in a direction that is transverse to planes of the graphite particles. As such, one of ordinary skill in the art at the time of the invention would have readily appreciated applying resin to the individual graphite sheets of Tzeng, in view of Mercuri, for the benefits detailed above, particularly the improvement in sealability/heat transfer properties.

6. Claims 1 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sauzade (US 4,878,152, of record) and optionally in view of Tzeng. Sauzade is directed to a process of forming a heat sink mounting for a printed circuit board comprising a plurality of graphite sheets, wherein the particles of the graphite sheet (define graphene layers) are highly oriented in the plane of said graphite sheet, <u>resulting</u>

in a highly anisotropic material or a material having a high lateral thermal conductivity (Column 2, Lines 56-65). While Sauzade fails to expressly define the thermal anisotropic ratio (lateral thermal conductivity to transverse thermal conductivity), Sauzade clearly desires a material having a high lateral thermal conductivity and further suggests that increased lateral thermal conductivities can be achieved by densifying a given material (transverse thermal conductivity would decrease / Figure 3 and Column 2, Lines 66+). The end result of densifying the material of Sauzade, which is expressly suggested by Sauzade, would be an increase in the thermal anisotropic ratio. Thus, depending on the intended use of the mounting and the desired anisotropy, one of ordinary skill in the art at the time of the invention would have found it obvious to form the graphite sheets of Sauzade with a thermal anisotropic ratio of at least 70, it being emphasized that Sauzade expressly desires a high lateral thermal conductivity, which in turn directly results in a high thermal anisotropic ratio, there being no conclusive showing of unexpected results to establish a criticality for the claimed anisotropic ratio (claimed ratio is achieved by densifying, which is taught by Sauzade). Tzeng is optionally applied to evidence the formation of graphite sheets in heat sink applications, wherein a high thermal anisotropic ratio (greater than 20) is achieved by increasing the density of the graphite sheets (Column 4, Lines 25-44).

Regarding claim 30, Sauzade suggests that the lateral thermal conductivity is a function of density, wherein increased density results in increased lateral thermal conductivity (Figure 3). It is clearly evident that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet

material with a lateral thermal conductivity of at least 350 depending on the desired anisotropic characteristics (by densifying graphite sheet material).

7. Claims 2-6, 18-27, 29, and 31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sauzade and Tzeng as applied in claim 1 above and further in view of Shane (US 3,404,061, of record).

As set forth above, Sauzade discloses a process of forming a heat sink for a printed circuit board comprising joining a plurality of graphite sheets, wherein a high lateral thermal conductivity is desired. While the reference is completely silent with respect to the specific method in which said graphite sheets are produced, one of ordinary skill in the art at the time of the invention would have readily appreciated the techniques of the claimed invention (starting materials, pressure application, intercalation/exfoliation) as they represent the well known method by which graphite sheets are commonly formed, as shown for example by Shane. Shane discloses a method of forming a graphite sheet comprising the steps of intercalating natural, graphite flakes, expansion/exfoliation of the intercalated flakes, and compressing or compacted the expanded graphite flakes (Column 3, Line 63 – Column 4, Line 74). As such, it would have been obvious to one of ordinary skill to form the graphite sheets of Sauzade in a manner consistent with that of the claimed invention in view of Shane since the claimed method is extensively associated with the manufacture of graphite sheets, as further detailed below.

Regarding claims 2-6, as stated above, the individual graphite sheets are initially compressed or compacted prior to being formed into a laminate (Column 4, Lines 50-

53). Upon be superimposed upon one another, a further amount of heat and pressure would be applied to form the laminated article of Sauzade. Additionally, Shane recognizes that the degree of anisotropy increases upon compressing or compacting the sheet material to increased density (Column 4, Lines 60-70).

With respect to claims 18-27 and 29, as previously stated, Shane evidences the well known method of forming graphite sheets comprising intercalating natural, graphite flakes, expanding/exfoliating said flakes, and compressing or compacting the exfoliated particles. In describing the compression or compacting step, Shane provides an exemplary embodiment in which a pair of superposed rolls (analogous to calendaring) are used (Column 5, Lines 70-75). While the reference fails to expressly describe the use of a die press or movable platen to achieve said compression or compacting, these techniques represent well known and conventional "compacting" means and one of ordinary skill in the art at the invention would have readily appreciated the use of either technique in the process of Sauzade, especially in view of the general description by Sauzade noted above. In addition, the roll pressing or calendaring of Sauzade is only exemplary and suitable compression or compacting would equally be obtained by a conventional die press or movable platen, there being no evidence of unexpected results to establish a criticality for either of these techniques.

Regarding claim 31, Sauzade suggests that the lateral thermal conductivity is a function of density, wherein increased density results in increased lateral thermal conductivity (Figure 3). It is clearly evident that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet

material with a lateral thermal conductivity of at least 350 depending on the desired anisotropic characteristics (by densifying graphite sheet material).

8. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Sauzade, Tzeng, and Shane as applied in claim 18 above and further in view of Mercuri (US 5,902,762, of record). The references, however, fails to suggest that the individual graphite sheets can be resin impregnated. Mercuri, though, is similarly directed to the use of flexible graphite sheets due to their desirable heat transfer properties, wherein the sealability of said graphite sheets is improved by resin-impregnating said sheets (Column 2, Lines 1-16). In particular, Mercuri recognizes that the anisotropy of said flexible, graphite sheets allows the resin to flow readily within the sheet in a direction that is transverse to planes of the graphite particles. As such, one of ordinary skill in the art at the time of the invention would have readily appreciated applying resin to the individual graphite sheets of Sauzade, in view of Mercuri, for the benefits detailed above, particularly the improvement in sealability/heat transfer properties.

Response to Arguments

9. Applicant's arguments with respect to claims 1-6 and 18-31 have been considered but are moot in view of the new ground(s) of rejection. Applicant contends that none of the prior art references relied upon disclose the claimed thermal performances (lateral thermal conductivity or a thermal anisotropic ratio).

As set forth in the rejections above, Sauzade and Tzeng recognize that increased lateral thermal conductivity, and thus increased anisotropic ratios, are attainable by densifying a graphite sheet material. Figure 3 of Sauzade expressly

depicts the relationship between density and lateral thermal conductivity, wherein a lateral thermal conductivity of 350 would have been within the purview of one of ordinary skill in the art at the time of the invention depending on the intended use of the product, it being noted that Sauzade expressly desires a high lateral thermal conductivity. Also, Tzeng teaches a thermal anisotropic ratio of 20 or higher, which suggests that it would have been within the purview of one of ordinary skill in the art at the time of the invention to form a graphite sheet material with a ratio of at least 70. Thus, the thermal performances detailed by the claimed invention would have been obvious in view of the teachings of Sauzade and/or Tzeng. It is noted that applicant obtains the claimed thermal performances by densifying a graphite sheet material (Page 14, Lines 18-30) in an analogous manner to that taught by Sauzade and Tzeng. Thus, there does not appear to be any unique processing, other than densifying, that results in the claimed thermal performances.

Conclusion

10. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

11. Any inquiry concerning this communication or earlier communications from the examiner should be directed to **Justin R Fischer** whose telephone number is **(703) 605-4397**. The examiner can normally be reached on M-F (7:30-4:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Ball can be reached on (703) 308-2058. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9310 for regular communications and (703) 872-9311 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0661.

Justin Fischer
Justin Fischer

August 1, 2003

Michael W. Ball
Michael W. Ball
Supervisory Patent Examiner
Technology Center 1700